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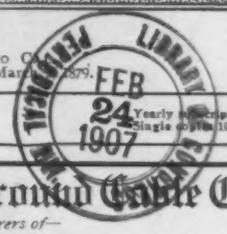

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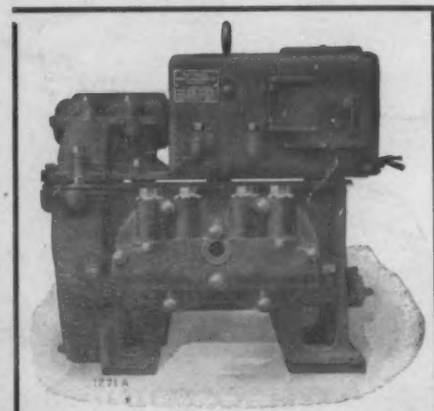

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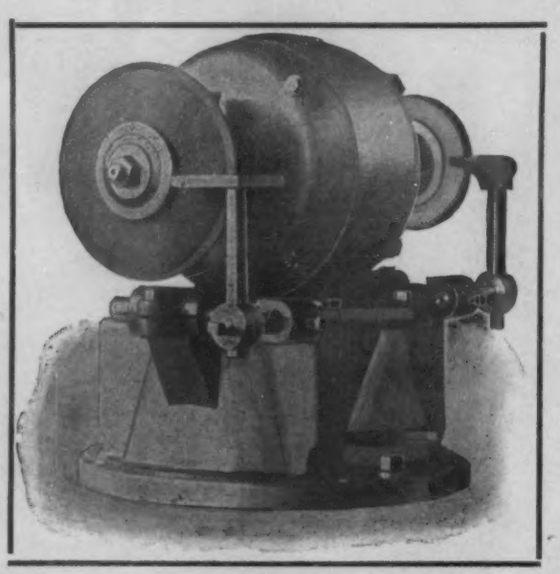

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VOLUME XVIII. SAN FRANCISCO, CAL., FEBRUARY 16, 1907 No. 7

The Street Railway Systems of Stockton, California

As the shipping center for the products of one of California's largest and most fertile valleys, the city of Stockton, with a population of 25,000, ranks among the important commercial cities of the state. Stockton has at present two independent electric street car systems, both of which are equipped with new cars and maintain a five-minute schedule on the principal streets, giving it a much better service than is usually found in cities of its size. The lines extend beyond the city limits for a few miles to give passenger service to the recreation parks and other places situated in the suburbs.

CARS OF THE CENTRAL CALIFORNIA TRACTION CO., SHOW ING STOCKTON'S NEW HIGH SCHOOL IN THE BACKGROUND

The regular five-cent fare is charged, but for the accommodation of school children, tickets are sold, arranged in book form, at the rate of two and one-half cents for each trip. These may be used between the hours of 7 a. m. and 5 p. m. except on Saturdays and Sundays. Tickets are also issued for the night school children and are good up to 10 o'clock.

Both companies have adopted the system of stopping at the near street corner, but this is not always rigidly adhered to on account of some local street crossing conditions.

The narrow-gauge line of the Stockton Electric Railroad Company began operation about fifteen years ago. In the summer of 1906, this company converted its entire line to the standard broad gauge. The old tracks were torn up with the aid of a traction engine, and small pile-drivers were used to break up the hard bitumen. Within the city limits the new tracks are built of 114-pound girder rails, 62 feet long. In the suburbs a 60-pound T rail is used. The rails are laid on redwood ties and imbedded in four inches of concrete, making an excellent road bed. The rails are bonded with a four-naught concealed bond. The trolley wire is of the overhead span construction.

The conversion of the road into broad-gauge necessitated the purchase of new cars for the entire system. These were built by the St. Louis Car Company, are 35 feet long and of

the double trolley-pole type. Each car seats forty passengers. The seats are arranged transversely and the inside seats are rattan upholstered. Each car is equipped with two General Electric type 80 motors, and the Christensen air brake equipment.

A well constructed red brick car barn, 160 by 114 feet, was recently built about two-thirds of a mile outside of the city limits. Eight tracks run into the building and thirty-two cars can be easily housed. Pit room for eighteen cars is provided, which is unusual in car barns of this size. Space in the rear part of the building has been allowed for the installation of machine tools, which are to be driven by a 7½ horsepower 500-volt direct current motor running at 1650 revolutions per minute. Separate locker rooms with individual lockers are provided for the car crews and the shop employes. The blacksmith shop and oil shed are situated behind the car barn in the company's construction yard.

Electrical energy for the operation of this road is obtained from the power house of the Stockton Gas and Electric Co. This power is at present supplied by two units, each of which consists of a General Electric two-phase alternating current machine of 200 kilowatts capacity direct connected to a Westinghouse direct current six-pole generator of 150 kilowatt capacity, which supplies power to the line at 550 volts. The alternating current generators are 12-pole machines of the revolving field type and operate at about 600 revolutions per minute. On the shaft between generators is mounted a driving pulley, and on the alternator end of the shaft is a small pulley for driving a General Electric 120-volt bipolar exciter, running at 1800 revolutions per minute.

Under normal conditions the power is taken indirectly from the standard line of the California Gas and Electric Corporation. From 60,000 volts, three-phase, the pressure is stepped down to about 2300 volts, two-phase, by means of Scott connected transformers. Current at this voltage drives the alternating-current generators as synchronous motors, which supply the mechanical power for operating the direct-current generators. Should the transmission line fail, the four machines of both units are operated as generators by belt connection with three tandem compound Ball engines of 250 horsepower each. The direct current generators supply power for the railway load as before, while the alternators now supply the city power and lighting circuits controlled by the Stockton Gas and Electric Company.

A Westinghouse motor-generator set has just been installed to provide additional power for the Stockton Electric Railroad Co. This consists of a 580 horsepower, three-phase induction motor to operate at 500 revolutions per minute at a pressure of 2200 volts, and a direct current, six-pole, 600-volt generator mounted on the same shaft, of 400 kilowatt capacity.

About a year ago the Central California Traction Co. completed the construction of its independent lines; and since then the cars of this company have been sharing the street car traffic of Stockton with those of the older company. Part of the cars were made by the St. Louis Car Co. and the rest by the J. P. Hammond Co. of San Francisco. These cars are of the single trolley pole type, are 32 feet long and seat forty passengers. The seats on the inside run lengthwise and are carpet covered. The motor equipment of each car consists of two Westinghouse type 92A 35 horsepower motors. National air-brake equipments are used on all cars.

THE COUNTY COURT HOUSE, STOCKTON, CAL.

A feature of these cars is that the headlight is arranged on the roof of the car instead of below the motorman's window, as is usually the case. There are several advantages derived from this arrangement. The headlights, on account of their increased elevation, add greatly to the ordinary street lighting and insure greater safety to passersby. The streets of Stockton are heavily shaded with trees and the motormen can more readily see prospective passengers waiting on the sidewalk corners.

When the cars first began to operate, the glare from these arc headlights considerably annoyed passing teams and auto-

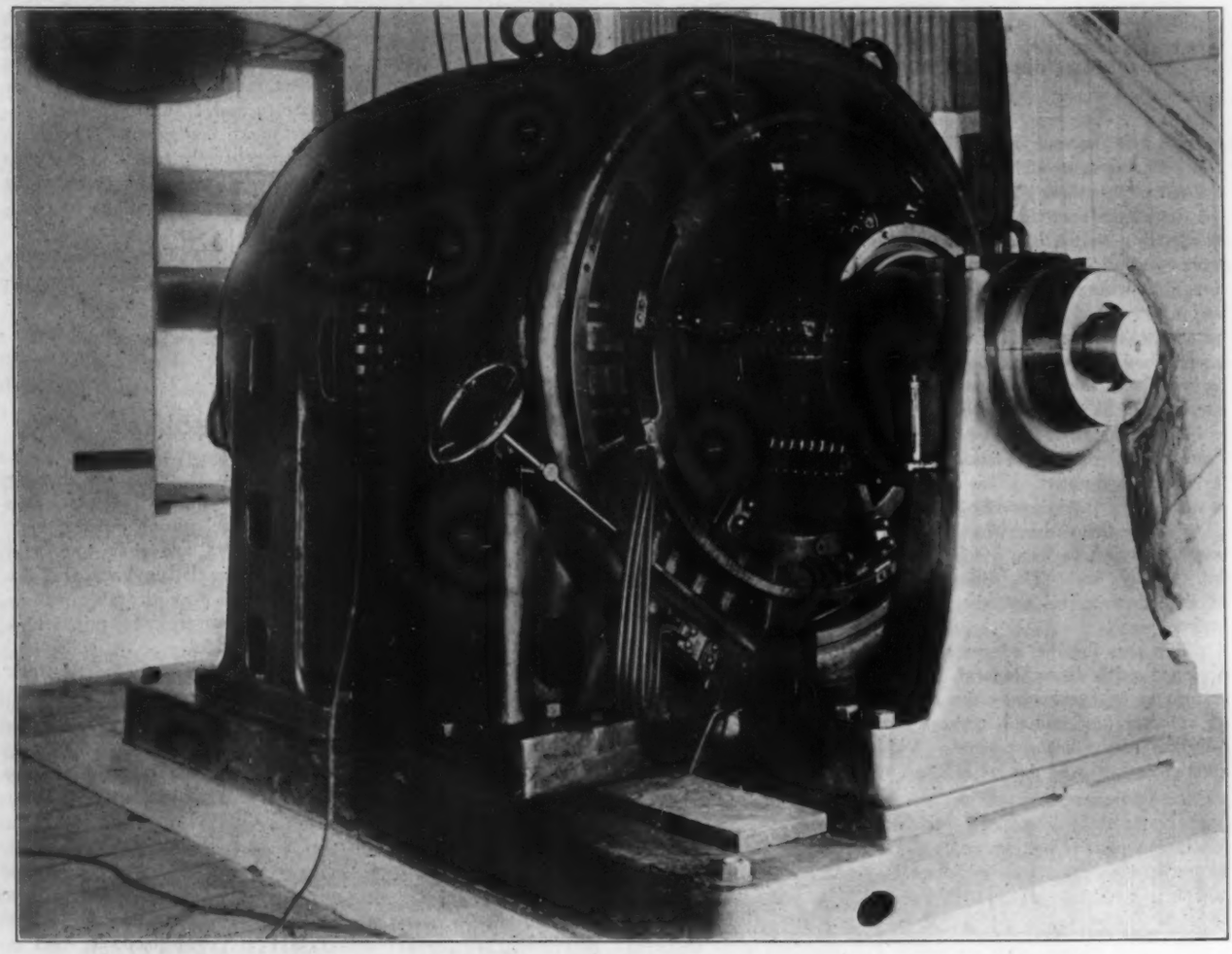
mobilists, as no dimmers are used. The people have, however, now become accustomed to them, and many automobilists greatly enjoy driving at night behind one of these cars on the opposite track as they can see ahead distinctly and are entirely screened from the glare of the headlight.

Instead of the usual wiring with resistance coils, considerable economy is effected by using the incandescent lamps as resistance, with the result that the cars are brilliantly lighted by energy that is ordinarily wasted.

The fenders are made of steel rods and are similar in construction to those commonly used in California. The tripping devices are, however, given special care to keep them in good working condition. Although no accident involving a human life has yet occurred with these fenders, about forty or fifty dogs have been picked up within the past year, and of these only two were injured, probably by being caught by the side of the truck.

inghouse oil-cooled transformers, Y connected on the primary side with neutral grounded, and delta connected on the secondary side. The taps are taken out at the middle. Power at this lower voltage is supplied to a Westinghouse motor generator set situated in an adjoining room. This consists of a 585 horsepower, three-phase, induction motor mounted on the same bed plate with a 400 kilowatt six-pole direct current generator, which supplies all the power needed for the operation of the cars. Ordinarily a station voltage of about 575 is maintained. The machines run at about 500 revolutions per minute.

The tracks are standard broad gauge and are built of 75-pound steel rails laid on redwood ties. From 6 to 8 inches of gravel ballast was used with concrete tamped under the rails in the usual manner. On streets paved with bitumen the space between tracks is filled in with concrete and covered with a 3-inch layer of bitumen; on other streets gravel is used. The rails are



400 KILOWATT MOTOR-GENERATOR SET IN THE SUB-STATION OF THE AMERICAN RIVER ELECTRIC CO., STOCKTON, CAL.

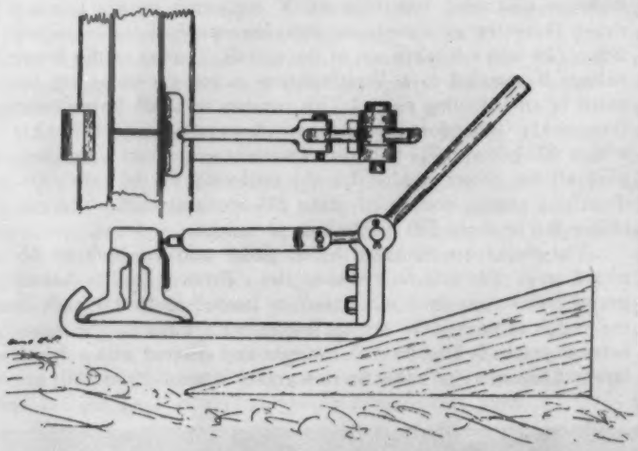
The present car barn is a corrugated iron building 168 feet long and 56 feet wide. It is traversed by four tracks with a liberal amount of pit room. The machine shop equipment includes a belt-driven lathe with a 24-inch swing and 12-foot bed, an 18-inch shaper, a 24-inch drill press, and a bolt cutter with a maximum capacity of 1½ inches. These together with the auxiliaries are driven by a Wagner 5-horsepower single-phase motor operating at 208 volts. In the rear of the building is a large yard for the storing of construction material.

Power for this line is transmitted a distance of 80 miles from the hydro-electric power station of the American River Electric Co. at Placerville. It is received at the local sub-station of the same company at 33,000 volts, three-phase; and, for the traction load, is stepped down to 2200 volts by three 150 kilowatt West-

bonded with a 0000 B. and S. gauge copper and soldered bond. The accompanying sketch shows a toggel clamp designed by Mr. H. W. Crozier, the electrical engineer of the company, for holding the bond in place while it is being soldered.

The Stockton lines of the Central California Traction Co. is but a part of an interurban system being built to Lodi, a distance of 15.2 miles, with a later extension to Sacramento—an additional distance of about 35 miles. The construction of this road includes several novel features, one of which is the prospective use of direct current at 1200 volts, not heretofore successfully realized.

The cars on the interurban lines proper will be operated from a third rail, while the overhead caternary construction is to be used on the city lines. This latter type is used at present in con-

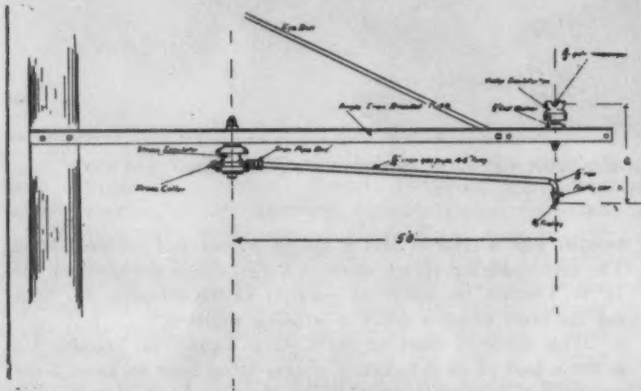


TOGGLE JOINT USED BY THE CENTRAL CALIFORNIA TRACTION CO. FOR HOLDING THE BOND DURING SOLDERING.

nection with the span wire construction on the lines now in operation in Stockton. The wires are supported by wooden poles set ordinarily about 120 feet apart, with the wires 20 feet above the top of the running rail. The steady brace shown in the accompanying sketch is used on every seventh pole along straight tracks and on every pole around curves to hold the wire in position. The trolley wire is a 000 B. and S. gauge copper conductor, and is suspended from a 3/8-inch galvanized iron messenger cable by adjustible spacers. The existing span wire construction will be retained on the straight runs if it is found to work satisfactorily with the new interurban cars. The trolley wiring on all curves is to be changed to the caternary type.

For the third rail construction a 40-pound A. S. C. E. standard rail of a conducting equivalent equal to 400,000 circular nils is to be used. This will be mounted on brackets set 12 feet apart. The bracket insulators will be of reconstructed granite, and the third rail will be covered on the top and sides by a board covering to keep foreign objects from coming in contact with the live rail. The difference in elevation between the top of the running rail and the bottom of the third rail is three inches.

The cars for the interurban traffic will be 50 feet long and equipped with four General Electric 75-horsepower 1200-volt motors to be operated by the Sprague General Electric system of multiple unit control. These motors will be geared for a speed of fifty miles per hour. Within the city limits the cars must necessarily be run at a lower speed, and the change from



STEADY BRACE FOR BRACKET CENTER POLE, CATENARY CONSTRUCTION.

a voltage of 1200 to that of 550 on entering the city will introduce no difficulties as far as the speed of the motors is concerned.

The lights, heaters and air pump will be operated on 550-volt circuits to be supplied by a dynamotor on each car during third rail contact. When, on entering the city, the change is made to a trolley potential of 550 volts, the dynamotor will be cut out and the auxiliaries will be operated directly from the trolley wire.

The work of constructing the interurban line is well under way; about two miles of track has already been laid.

To supply the additional electric power required for the operation of the interurban line, a new sub-station is to be built in which will be installed two motor generator sets of 500 kilowatt capacity each. Suitable transformers will be provided for stepping down the voltage from the high tension transmission line to that required for operating the induction motors.

The Central California Traction Co. has admirable facilities for receiving and handling construction materials for the new road. Spur tracks have been built from the city lines so that the company can load its cars directly from the cars of the Southern Pacific, the Santa Fe or the Western Pacific Railway systems. For general hauling and transporting materials of construction the company built a flat motor car at its own shop, which, on account of its many merits, is the pride of every shop employe of the company. This car weighs 21 tons and carries five tons of steel rails as ballast. It is equipped with four Westinghouse, 35-horsepower motors and a Westinghouse combined straight and automatic air brake equipment. The automatic air brake is similar to those generally found in the cabs of steam locomotives. The circuit breaker can be operated by pulling a suspended cord, which is a great advantage in coupling cars.

The officials of the Central California Traction Company are: E. P. Hilborn, general manager; R. S. Masson, consulting engineer; H. W. Crozier, electrical engineer; and D. S. Unruh, roadway engineer.

PACIFIC COAST TELEPHONES.

Pacific coast states claim the greatest telephone density of any section of the country—if not the world. In California, Washington and Oregon, the telephone development has been marvelous and the prospects are that 1907 will eclipse all records in the extension of existing lines and the construction of new systems. The following table shows the number of telephone stations according to population in the larger cities of the coast states:

	Population.	Stations Per 100
Los Angeles	220,000	13.15
San Francisco	325,000	5.04
Portland	175,000	10.90
Seattle	182,000	10.10
Oakland	106,000	11.02
Spokane	56,320	19.23
Tacoma	75,000	10.86
Pasadena	23,000	18.20
San Jose	32,000	16.53
Sacramento	40,000	11.32
Fresno	23,000	16.58
Berkeley	32,000	10.92
Alameda	18,000	12.65
Bellingham	25,000	9.54
Walla Walla	21,000	9.80

GOOD ENGINEERING.

In the "One Horse Shay," Dr. Oliver Wendell Holmes, as well as the good deacon, builded better than he knew; for it should not be considered merely as a logical triumph, but as an ideal of the accuracy of engineering calculations in correctly estimating the strength of each part, and exactly providing for the depreciation of the whole work.—Mr. C. J. H. Woodbury.

THEORY OF ELECTROLYTIC CORROSION.*

By Prof. Ganz.

Electric conductors are divided into two classes, namely.

1. Metallic conductors, which transmit electric currents without chemical decomposition; and,

2. Electrolytic conductors, or electrolytes, which transmit electric currents by a corresponding transfer of ions in a solution, thus producing chemical decomposition at the electrodes.

The metals are the most common metallic conductors. Chemical compounds in solution, which can be decomposed by an electric current, are electrolytic conductors, or electrolytes.

Pure water has such a high resistance that it may practically be considered a non-conductor. Water is made conducting by the addition of salts or acids in solution, and conduction through water is, therefore, always electrolytic. For the present purposes we need only consider the electrolytes consisting of salts dissolved in water. The conducting terminals by which the current is led into and out of an electrolyte are called electrodes. The electrode by which the current enters is the anode, and the one by which the current leaves is the cathode. The following brief explanation of electrolytis conduction is in accordance with the modern theory of electrolytic dissociation:

When a salt is dissolved in water, some of the molecules separate or dissociate into two parts, one part having a positive electrical charge, and the other a negative electrical charge, and these parts are called ions. The metal part, or the hydrogen, is the positive ion, and the acid part is the negative ion. For instance, copper sulphate, $CuSo_4$, when dissolved in water, dissociates into the positive metal ion Cu, and the negative acid ion, So_4.

An electric current is transmitted through an electrolyte by the motion of these ions. The metal or hydrogen (positive) ions travel in the direction of the current and carry positive electrical charges to the cathode, and those metal ions, called cations, are deposited upon or are liberated at the cathode. The acid (negative) ions travel against the current and carry negative charges to the anode, and these acid ions, called anions, will corrode the anode if it is a metal which combines chemically with these anions. The cathode is never corroded.

For instance, if the electrolyte is common salt dissolved in water, the anions are chlorine, and an iron anode would be corroded, the iron forming ferrous chloride; the cations are sodium, and these would decompose the water and liberate hydrogen at the cathode. With an electrolyte of copper sulphate dissolved in water, and a copper anode, the latter corrodes into copper sulphate and dissolves while metallic copper is deposited upon the cathode. These examples furnish an illustration of the fact that the corrosive action of the current results in supplying the electrolyte with an equivalent to the amount of salt decomposed by the current, so that the electrolyte is continually replenished with salt and its electrolytic conducting power is thereby maintained. This salt will contain the metal ions of the anode, or hydrogen, and may be different from the original salt which started the action.

The rate at which the ions are liberated at the electrodes is proportional to the current strength. With an oxidizing anode, the mass of anode corroded by one ampere in one second, is equal to the electro-chemical equivalent of the metal of the anode. This is 0.00029 gramme for iron (ferrous). From this the mass of iron corroded by one ampere in 1 year is, 0.00029 x 60 x 60 x 24 x 365 grammes, or, 0.00029 x 60 x 60 x 24 x 365 x 0.002205 = 20 pounds (approximately). The electro-chemical equivalent for lead is 0.0010718, and the mass of lead corroded by one ampere-year is, 0.0010718 x 60 x 60 x 24 x 365 x .002205 = 74 pounds (approximately).

The separating of the metal or hydrogen ion from the electrolyte at the cathode absorbs energy from the electric circuit and generally produces an electromotive force in the opposite direction to the current. The oxidation of the anode supplies energy to the circuit and generally produces an e. m. f. in the direction of the current. If an oxidizing anode is of the same metal as is being deposited upon the cathode, and the electrolyte is the same at the anode and cathode, there is no resultant e. m. f. due to the electro-chemical actions, and the only e. m. f. consumed is that due to the resistance of the electrolyte in accordance with Ohm's law, exactly as with a metallic conductor.

If the metal deposited at the cathode is different from that oxidized at the anode, or if hydrogen is liberated at the cathode, or if the electrolyte at the cathode is not of the same composition or density as at the anode, there will be a resultant e. m. f. which may be either in the same direction as the current or in the opposite direction to the current.

Street soils generally contain salts, principally chlorides, nitrates and sulphates, dissolved in water, and this makes them electrolytic conductors. It has been claimed by some that soils conduct to a considerable extent metallically; this has, however, been disproved, and it is now understood that soils can only conduct electrolytically. The conductivity depends, then, entirely upon the chemical composition and wetness of the soil, which vary greatly in different localities.

In practically all single-trolley roads the trolley wire is connected to the positive pole of the dynamo, and the rails are connected to the negative pole. In cheaply constructed roads the connection to the rails is only made at the power station, and the rails are, therefore, expected to serve as the return conductor for all current. In order to make the rails a continuous conductor they are bonded at their joints, ordinarily with copper wire.

We will now consider the result of this construction. The rails are in contact with the ground for their entire length, and as the street soil is a conductor, part of the return current must shunt through the ground in accordance with the law of divided circuits. This current, which as it were, leaks from the rails through the ground, is called stray current. In the simple case under consideration (rails connected to the negative pole at station only) the potential of the rails increases with the distance from the station and with the number of cars in operation. Neglecting any slight counter electromotive force, the amount of stray current varies directly with the potential difference in the rails and inversely with the resistance between the point at which the stray current leaves the rails and the point at which it again enters the return conductor. The stray currents would disappear, then, either with zero potential differences in the rails, or, with an infinite resistance to their path, two conditions which are clearly impossible with a single-trolley electric road, and, therefore, stray currents are always produced by such roads. In some electric railway stations the negative busbar is grounded by means of earth plates. Since this diminishes the resistance to the ground, the result of this practice is to increase the stray currents.

If the ground through which the stray currents pass contains metals such as water pipes and gas pipes, which have a high conductivity, these currents will largely pass through such metals. In general, in districts distant from the power house the stray currents flow through the intervening soil from the rails to the pipes; these districts are, therefore, called negative districts and the pipes in them negative pipes. In the district surrounding the power house the stray currents flow from the pipes through the intervening soil to the rails; these latter districts are, therefore, called positive districts, and the pipes in them positive pipes. Between these two districts the stray current flows from rails to pipes or from pipes to rails, depending upon the distribution of cars, etc. These intermediate districts are sometimes called neutral districts.

Since every electric circuit must be completely closed, all current which leaves the plus terminal of the dynamo must return to the negative terminal. For this reason all current which escapes from the rails in the negative district

*A paper prepared for the Committee on Electrolysis and submitted to the American Gas Institute.

and reaches the pipes, must again leave the pipes in the positive district in order to return to the negative pole of the dynamo. The electric current is in this respect very different from gas or water, which latter can leak from a pipe and become diffused through the ground.

With the stray currents in the ground and on the pipes we have, then, the conditions of an electrolytic cell, the pipes and rails being the electrodes, and the dissolved salts in the soil, the electrolyte. In the negative district the current flows from the rails through the soil to the pipes, and the rails (anodes) are corroded, while the pipes (cathodes) are not corroded. The corrosion of the rails does not concern the pipe-owning companies, and they have considered these negative destricts as safe districts. In the positive district the current flows from the pipes to the soil and the pipes (anodes) are corroded by the current. For this reason the positive district has been called the danger district.

The reason for connecting the negative, rather than the positive, pole to the rails was to concentrate the positive district within the region surrounding the power house; it was hoped in this way to restrict the pipes endangered by electrolysis to this definite and comparatively small region, so that they could be watched and remedies applied. It has been found, however, that there are many points in the negative and intermediate districts, for instance, at joints, where current may leave a pipe and produce electrolysis.

In most large, single-trolley systems the rails are connected to the negative busbars by return feeders at a number of places besides directly at the power station. At each point of connection of such a return feeder to the rails a positive region is established, and some stray currents will leave the pipes in this region to return to the rails near such points.

The danger region of a piping system is, in fact, by no means confined to the so-called positive districts, but at every point where current leaves a pipe to pass into wet soil, electrolytic corrosion must take place. An iron pipe is ordinarily not in uniform contact with the surrounding soil, owing to high resistance oxide coating, etc., so that the current leaves in spots where there is good contact with the soil. The result of this is that the corrosive action is concentrated at these spots so that holes or pittings are produced by the corrosion.

It has been stated that one ampere-year will corrode 20 pounds of iron or 74 pounds of lead. Secondary chemical reactions may, however, greatly increase this amount of corrosion. It must also be understood that this 20 or 74 pounds of corrosion occurs at every point at which the current leaves the pipe for wet ground, and that the same ampere of stray current can leave and again return to a pipe any number of times in its path, depending upon the electrical conditions; so that any number of times 20 or 74 pounds of corrosion may be produced by a single ampere of stray current in 1 year.

It has been shown that a small fraction of a volt (Jackson says "a mere directive force, in the nature of a pressure") will produce enough current to cause electrolysis with the conditions generally present with underground pipes. This has been proven experimentally by a number of investigators, notably by Jackson (1), Fleming (2) and Larson (3).

The published results of some laboratory tests with alternating currents seem to indicate that these may also produce electrolysis, the extent of which is probably a small fraction of that produced by an equal direct current. Alternating currents would, however, corrode both electrodes. Electric trolley roads have only very recently begun to use alternating currents, and, so far, no practical experience has been furnished from which it can be concluded whether electrolytic corrosion is practically negligible or not. It is, therefore, not safe to assume, as some writers have done, that the substitution of alternating for direct currents on single-trolley roads would eliminate electrolytic troubles.

It is clear from the foregoing that the electrolytic corrosion is produced where the current passes from a pipe to wet soil, and that the amount of corrosion depends upon the strength of the current and the time during which it acts. The fact that a pipe is positive to some other conductor is not in itself evidence that electrolysis is taking place; there must, in addition, be an electrolytic conductor, in the nature of wet soil, between the pipe and the negative conductor, so that the potential difference can cause a current to flow from the pipe to the soil. The smallest quantity of a soluble salt in this soil is sufficient to start the corrosion, and this action of itself replenishes salt required for electrolytic conduction, as shown before. A high potential difference may, even under certain conditions, indicate a high resistance and a correspondingly small current with little corrosion, while a low potential difference may indicate a low resistance, and a large current with a correspondingly large amount of corrosion. Electrolytic surveys which consist only of voltmeter readings are, therefore, not sufficient to determine the existence and extent of electrolytic corrosion. Direction and strength of current flow in various parts of the system are required in addition to the voltage readings.

1. "Corrosion of Iron Pipes," by Prof. D. C. Jackson, "Journal of the Association of Engineering Societies," September, 1894.

2. "The Electrolytic Corrosion of Water and Gas Pipes by the Return Currents of Electric Tramways," by Dr. J. A. Fleming, "The Electrician," London, September 16, 1898.

3. "Electrolytic Action of Electric Current Upon Iron Pipes in the Ground and the Resulting Polarization," by Prof. A. Larson, American Water Works Association Proceedings for 1903.

THE METAL ALUMINUM.

It is of interest to remember that, nearly a hundred years ago, Davey dissolved alumina, but failed to isolate the metal, although he named it. It was not until the year 1855 that the French chemist, Deville, showed that aluminum could be prepared on a large scale and in a compact form without very much difficulty. Although the mineral cryolite, which is found in Greenland and is a double fluoride of aluminum and sodium, was the one first used for the manufacture of aluminum, nowadays bauxite is used for the purpose. Bauxite is a clay consisting chiefly of alumina or oxide of aluminum, and oxide of iron. Electrolytic methods are employed in the preparation of the metal, and full advantage is taken of the hydraulic power at Neuhausen, and, on a larger scale, at Niagara, to obtain the current necessary. Aluminum is very malleable and ductile, and in tenacity it approaches iron. It fuses at about 700 degs. C., and does not oxidize. It has been known for some time that aluminum forms suitable alloys with copper, although the above-mentioned reports place the properties of all of these alloys on record for the first time. Aluminum appears to alloy with tin, and has been used for optical instruments, and it is therefore possible that further research will be done on aluminum and copper alloyed with tin.

PRIVATE TELEPHONE FOR A PRISONER.

Several centuries ago an English poet who was sent to prison wrote that bars and locks cannot confine the man whose mind is free and unfettered. Doubtless the same thought has led a white woman confined in an Alabama county jail for manslaughter to demand a telephone in her cell. Yohlande Degg is the prisoner and she has appealed for a new trial to overthrow the sentence which imposed a penalty of twenty-three years' imprisonment. Having powerful friends, she obtained many favors denied the ordinary prisoner, and one of her requests was to have a telephone in the cell for her personal use. It was granted her after some delay, and now she can call up and talk with all her old friends who have not dropped her from their list of acquaintances. This is believed to be the first case on record of a convicted prisoner being allowed a private telephone.

FLEXIBLE CORD MUST BE TESTED.

After several meetings of the joint committee formed by representatives of the insurance interests and the advisory committee of the flexible-cord manufacturers, it was deemed advisable to devise ways and means of testing all flexible cord, both pendant and portable, manufactured under the rules of the National Board of Fire Underwriters, as recommended by the Underwriters' National Electrical Association. This is to restrict the introduction into commercial use of any cord which would prove inferior to the National Electrical Code standard, so as to protect reliable manufacturers against inferior goods, in competition.

Specifications for these factory tests have been drawn up by the committee and are as follows: "Each coil of duplex cord shall be tested dry by the application of 1,500 volts alternating current simultaneously to each of the two conductors, contact being made on bare copper wires at either end of the coil, and care being taken that the other ends of the conductors do not come together. Alternating current is to be supplied from a transformer with an actual working capacity of at least five kilowatts."

These factory tests will be conducted in a similar manner to those now carried on under directions of the Wire Inspection Bureau in the manufacture of National Electrical Code rubber-covered wire.

Stamps will be issued by the Wire Inspection Bureau and sold to the different manufacturers at a charge of 2½ cents per thousand running feet of cord tested. These stamps are to be attached to the coils of tested cord by the manufacturers themselves, and are to serve as a guarantee that cord so stamped has successfully withstood the tests specified by the bureau. They will be furnished for 250-foot, 500-foot and 1,000-foot coils, as desired.

The majority of flexible-cord manufacturers have recently agreed that on and after March 1, 1907, all National Code cord manufactured by their companies shall be made up under the new specifications and duly tested, and will bear identification mark of the Wire Inspection Bureau.

It is understood that a reasonable time will be allowed, after the date mentioned, for the disposal of Code cord not bearing the stamp of approval of the Wire Inspection Bureau, on all such cord manufactured before March 1, 1907, and with this understanding, the April list of "Electrical Fittings" will contain the names of flexible-cord manufacturers agreeing to the tests of the Wire Inspection Bureau and using stamps as guarantee that these tests have been properly made.

No cord will be considered as having been tested which does not carry an identification stamp. Stamps are to be securely fastened to the shipping tags attached to the coils. All stamps are to be canceled by the manufacturer when used, the date of manufacture of cord, also, being plainly shown.

Hugh T. Wreaks, 43 Cedar street, New York City, is secretary of the Wire Inspection Bureau, and it is from a circular issued by him that the above information is obtained.

In addition to furnishing gas and electric light free to aid the work put upon the Relief Committee of Cincinnati, O., brought about by the extremely high water mark in the river, the Union Gas and Electric Company has forwarded to Mayor Dempsey a check for $500 for the fund for the relief of those who suffered by the flood.

THE BUSY SIGNAL.

Many telephone subscribers entertain a grudge against the "busy" signal that is ill-founded. It is natural, perhaps, for one to become impatient on hearing the "nothing doing" buzz when he is in a hurry to obtain the desired connection, and some often suspect that the signal is given because the operator at central is negligent and careless and anxious only to get rid of the call. The truth is, however, that the busy signal is considered by telephone experts as one of the best time-savers devised in the development of apparatus. In fact, the signal was invented for the purpose of saving the time of both the subscriber and the operator. It facilitates the work of the operator by doing away with the necessity of informing the caller that the line is busy, saving the operator the time consumed in this way, enabling her to give other callers quicker service in answering when the board is busy.

It also saves time for the caller, as the moment he hears the buzz he knows that the line is busy without waiting to be told.

Many subscribers have got the idea through frequently hearing the buzz that it is the fault of the operator who does not care to take trouble to make the connection. The fallacy of this impression is shown by the fact that it is more trouble for the girl to give a busy signal than it is to make the connection.

Prompt and efficient service by the operating department is the foundation of success of a telephone company, and great care is observed to see that the operators at the switchboards give as little cause for complaint as possible. A strict surveillance of their work is maintained at all times. In all large exchanges every girl is required to answer every call and try to get the party asked for. A supervisor stands constantly back of the girls at the switchboard watching their movements and seeing that they give quick service. In addition to this a girl is seated at the "supervisory board" who can get in on any line and hear what the operator is doing.—Telephony.

HYDRO-ELECTRIC PLANTS OF UNITED STATES, CANADA AND MEXICO*

Under the title "Hydro-Electric Plants of the United States, Canada and Mexico," Arthur W. Clapp, M. E., E. E., 1164 Monadnock building, Chicago, Ill., will shortly give to the electrical engineering field the first volume of one of the most exhaustive treatments of this branch of the electrical industry that has been published for some time. Every plant of over 500 horsepower capacity, in the countries covered, will be described with the object of laying before the profession the intimate details of each hydro-electric power plant, its equipment, its location, its purpose and unique features.

The author announces that but few of the plants described in this work have ever appeared in print of any form; and the manner in which the matter is presented in the separate articles will bring the subject vividly before the reader.

The work will be in two or more volumns of 500 pages each. Each plant described illustrated with photographs grouped on one page. The description of the plant gives the following subjects in detail: Hydraulic features, construction of dam and power house, detail of electrical and switchboard equipment and pole line, each article consisting of from 3,000 to 5,000 words. There are in all about 350 hydro-electric plants of over 500 horsepower in the countries above mentioned. To date about 250 have been described in the material received.

Accuracy as to data furnished will be the main feature of the work, the statistical matter being furnished by engineers now in control of the individual plants or by those under whom the plant was constructed. Before publication final proofs will be submitted to each company operating the plant described for correction.

This work to the extent of 2,500 copies is to have a free distribution among the electrical engineers in charge of the plants described and to those parties who contemplate the erection of hydro-electric plants. This distribution is made possible by the co-operation of a number of companies who are interested in the manufacture of hydro-electric equipment. A compilation of this character will be of great assistance as a reference book for years to come, and the author will be pleased to receive any information or statistics that will be of interest to the profession and valuable for publication of these volumes. As there will be an excess of a few copies of this work, Mr. Clapp will furnish gratis a complete set of the volumes to any reputable engineer or company upon application.

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EDITORIAL.

Conservation Charges by the Forest Service

We are glad to publish in another column of the "Journal" two letters from Mr. G. W. Woodruff, chief law officer of the Forest Service, which letters treat of the proposed charge against hydro-electric power companies for the use of Forest Reserve land. Mr. Woodruff's letter of January 28th refers to the editorial which appeared in the issue of December 22, 1906, of the "Journal."

It can hardly be said that the letters of Mr. Woodruff contain any new matter not found in the circular letter entitled, "Memorandum Concerning Conservation Charge," which was sent out by the Forest Service in November, 1906, and which we also publish in this number. There are certain statements made by Mr. Woodruff, however, which we most respectfully desire to discuss.

It is said that on May 31, 1905, the Attorney-General sent the Secretary of Agriculture an opinion to the effect that it is legal for him to charge for any use of Forest Reserve land products or resources granted exclusively to individuals or companies as against the rest of the people.

We believe that no one will object to a charge being made if such charge is based upon the above regulation or requirement. The truth is, however, that there is probably not a single hydro-electric plant in the United States that actually uses an acre of Forest Reserve land exclusively as against the rest of the people, unless it be, perhaps, the small area required in some instances for a power station building, for which power house site the company would be glad to pay to the Government either a proper rental or recompense the Government in any other way the Forest Service should dictate.

When a reservoir is constructed upon Forest Reserve land by a power company, the storing of this water is a decided advantage to all of the people of that particular district, and especially to the agricultural interests in the valleys below. If the Department of Agriculture had unlimited means at its disposal, large sums would undoubtedly be expended for the construction of just such reservoirs as are built by the power companies. Further, the more reservoirs that are built, no matter by whom, for the storage of the winter floods, the greater will be the productiveness of the lands in the valleys below.

Nor are such reservoirs exclusive—not only the power companies, but everyone else, would welcome the building of other reservoirs. The more that are constructed, the greater will be the benefits to all.

The roads which have been built on Forest Reserve land by the power companies are not exclusive. They are, in fact, public highways, well built at heavy cost to the hydro-electric companies, and are in almost every case kept in repair by the builders. Neither is a ditch line or pole line exclusive. There may be other lines belonging to other companies, in fact, as many as are needed. No power company desires to exclude anyone from the Forest Reserve. To compare the purposes of the power companies to the actual and exclusive use of Forest Reserve land by railroads, owners of live stock and others, whose occupation of the land is exclusive, is manifestly not only unfair but absurd. We are most firmly of the opinion that the power companies ask no privileges that are exclusive or which are against the interests of the people at large.

Our Forest Service friends evidently believe thoroughly in the convincing ability of the word "reasonable." It is of importance to note, however, that no one outside of the Forest Service will, or by any possibility can, have an important part in the decision of what is or is not a "reasonable" charge.

The first two of the three charges proposed, viz.:

First, a reasonable charge per acre for the ground actually occupied by other than lines, and

Second, a reasonable charge per mile for lines such as transmission, pipe, ditch, canal, tramroad, etc., would undoubtedly be cheerfully accepted by the power companies if such charges were definitely fixed and reasonable, taking into consideration the fact that the occupancy of Forest Reserve land for reservoirs, highways, trails and pole line clearings, which last, as has been pointed out, are the best of fire breaks, is of enormous value to the Government and to the people, as well as of value to the power companies.

The so-called "conservation" charge is, however, neither reasonable, rational, sensible nor justifiable.

If, as the Forester asserts, the Government, by maintaining a forest cover upon the watershed above the intake, furnishes an actual value to the power company, because the forest floor and conditions conserve the water and regulate the flow in a way which otherwise must be done by costly reservoirs, then to be consistent, every user of the water coming from this watershed for the irrigation of land or as a domestic water supply, or for any purpose whatsoever, should also be required to pay a conservation charge to the Forest Service, and what is more important, when a power company builds costly reservoirs, both the Government and the users of water below should recompense the power company for conserving the water and regulating the flow with reservoirs, since the result is the same as when the forests are preserved over the upper watershed by the Government through the Forest Service.

Finally, to use as a measure of the conserving effect of the forest maintained by the Government, not only the amount of water used, but the fall or head as well, is unreasonable from any standpoint. The amount of electricity produced is rarely with any power company a measure of the so-called conservation by the Government, due to the maintenance of forest-covered watersheds. The amount of electricity produced might depend very much more upon the reservoirs constructed by the power company than upon the maintenance of a somewhat uniform flow due to the preservation of the forests.

It is said that the present Forester certainly will make no charge high enough to cause a prudent business man to hesitate about taking out a new permit or continue to operate under an old one. Further, that every company will be given an agreement which will be binding for a series of years, as far as the Forest Service is concerned, but will not limit the life of the permit itself, and, finally, it is said that the objection to the payment of the proposed charges is merely the natural aversion which all people have to giving up money so long as there is a chance of holding it.

To all of the above we wish to say that the proposed conservation charge is excessive, being practically a confiscation of three per cent of the gross income of the companies, and the fact that this charge may be certain makes it all the more burdensome. We further believe that the Forest Service officials would also have a natural aversion if all of their appropriations were subject to a reduction of three per cent in the interests of those for whom the work of the Forest Service is of the greatest benefit.

CORRESPONDENCE.

As mentioned in our editorial columns this week, we are in receipt of two letters from the chief law officer of the Forest Service, which we publish below with the consent of the writer. We believe that our readers will also be interested in the circular letter of the Forester, sent out from Washington in November last, to the electric power transmission companies of the Pacific Coast.

UNITED STATES DEPARTMENT OF AGRICULTURE FOREST SERVICE.

Washington, January 28, 1907.

Editor Journal of Electricity, Power & Gas, 606 Mission Street, San Francisco, Calif.

Dear Sir: My attention has been called, somewhat late, to the first editorial in your publication of December 22, 1906. The Forester is away from Washington, and I therefore hasten to send you copy of a letter written on the question of the "conservation" charge, which will explain some of the matters touched on in your editorial, concerning which you did not have full information at the time.

It will explain the Forester's intention when only a part of the plant is in the forest reserve.

It also explains the method by which the Forester intends to make charges certain, and that he will exercise the utmost care to make them reasonable, in order to avoid either prohibiting the development of electric powers or confiscating plants already constructed.

I hope the crude points contained in the enclosed letter will appeal to you as part of the entire defense which could be made to show the justice of the proposed "conservation" charge.

If the proposed maximum charges, which were put forward for consideration to the hydro-electric companies rather than as final, are shown to be too great, the Forester will certainly reduce them. Very truly yours,

(Signed) G. W. WOODRUFF, Chief.

UNITED STATES DEPARTMENT OF AGRICULTURE FOREST SERVICE.

Washington, January 29, 1907.

Mr. Philip W. Ayres, 7 Park Ave., Winchester, Mass.

Dear Mr. Ayres: Your letter of January 17 has remained unanswered because of rush of business. Your reminder about the getting together of the Governors, etc., came in very handily, because Governor Glenn's train was very late, and he telegraphed to the Forest Service for instructions.

Concerning the charge to hydro-electric power companies for rights of way and privileges within the forest reserves, I am very glad to give you complete information to forward to Governor F. W. Rollins.

On May 31, 1905, the Attorney General sent the Secretary of Agriculture an opinion to the effect that it is legal for him to charge for any USE of forest reserve land, products, or resources granted EXCLUSIVELY to individuals or companies as against the rest of the people. There is no thought of charging for ordinary and general use, such as hunting, fishing, camping, traveling, etc. The reserves are considered by the Forester to be the property of all the people, and so long as any of the people wish to use this common property in a way which is neither PERMANENT nor EXCLUSIVE, the Forest Service is simply their *servant* to protect their property, make it accessible, improve it, and even give advice as to desirable places for camping, etc. All this is done gladly and freely.

When, however, a man wants to build a small hotel, to turn his cattle in to graze the forage, to cut timber other than the small quantities needed for building and fuel purposes by settlers, to construct and maintain reservoirs, canals, ditches, pipe lines, transmission lines, power-houses, etc., the Forester, following the Attorney General's opinion, is making a reasonable charge for such exclusive use.

Congress has provided that the money received from such charges shall become a special fund for the "administration, protection, improvement and extension of forest reserves." This fund has been, in my opinion, the salvation of the forest policy in the United States. Congress would not have appropriated sufficient money to maintain the necessary field force to protect

the people's property; but from the charges, which amounted to $767,000 last fiscal year, and will be $1,250,000 this year, the Forester has been able to gradually lift the field force both in numbers and quality above the ruinous minimum.

There have been grumblings about these charges. This is natural. Every business man considers that any saving in expense is so much advantage to him. Owners of live stock paid in over half a million dollars last fiscal year with considerable reluctance, but are now, in the main, glad that the charge is being made.

The first people to make a decided and continued objection were the hydro-electric power companies of which the Edison Electric Company is one of the permittees involved. The proposed formula to determine the rate of charge in all privilege cases had been fixed for convenience and uniformity as follows: It was assumed that any or all of three elements might enter into any privilege charge. They were:

(a) A reasonable charge per acre for the ground actually occupied by other than *lines*.

(b) A reasonable charge per mile for lines such as transmission, pipe, ditch, canal, tramroad, etc.

(c) A reasonable charge, measured by some certain and convenient method, for any resources, opportunities, or services furnished by the government to the permittee besides "area" and "length." This, for convenience, is called "conservation."

The hydro-electric companies did not object any more seriously to "(a)" and "(b)" than other permittees who would prefer to have such expense, but they claimed, and still claim strenuously that the United States does not furnish, in addition to area and length, that which the Secretary of Agriculture and the Forester claim it does.

The Forester asserts that the government, by maintaining a forest cover upon the watershed above the intake, furnishes an actual value to the permittee, because the forest floor and conditions conserve the water and regulate the flow in a way which otherwise must be done by costly reservoirs. He claims that the amount of water used (although there is no thought of charging for it, since the water is granted directly by the State) is nevertheless a proper *measure* of the conserving effect of the forest maintained by the government.

He also claims that the fall, over which the pipe or ditch is carried, is a resource or element furnished by the government which enter directly into the production of electrical energy. Without the fall, the water granted by the State and owned by the company would be of absolutely no value for generation of electricity.

Therefore, if as the Forester claims, the water is conserved and the fall is furnished by the United States, and as the Attorney General asserts it is proper for the Forester to make a *reasonable* charge for what the Government furnishes, it follows, as a matter of course, that the electricity produced is a *measure* of the two elements which enter into it, namely, the water conserved and the fall furnished.

Therefore, the Forester has announced to the electric companies that they must pay for "conservation," either by an annual flat rate advance payment per theoretical horsepower (this alternative maximum rate was proposed to be 75c) or by a rate per electrical unit developed (this alternative maximum rate was proposed to be 20c per thousand kilowatt hours).

There are two additional considerations in these charges which the Forester wants to call particularly to the attention of all interested persons:

(1) The proposed alternative maximum rates would be reduced proportionately if any part of the watershed above the intake were not forest reserve land, and if any part of the fall furnished is outside of the forest reserve. There are several combinations which would be considered under this heading, and in most cases would result in a reduction of charge.

(2) The Forester understands that the very life of business demands that charges must be *certain*. The companies complained that, even though the present Secretary and Mr. Pinchot might be trusted to refrain from increasing the charges to the point of confiscation, some socialistic change in the government would endanger the complete loss of their property. To meet this the Forester has recently evolved an adequate arrangement. Every company will be given an agreement which will be binding for a definite number of years upon successive administrative officers, but will not limit the life of the permit itself to any number of years, leaving that necessarily to the effect of the law under which each privilege was obtained. The charges for that period will be made definite.

(1) By fixing the initial rate of charge definitely in the agreement.

(2) By providing that the charge may not be increased for five years after first payment, nor thereafter in any period of five years more than a definite percentage, say one-fourth.

(3) By fixing some definite number of years to be arranged by conference with the separate permittees (say forty) during which the agreement concerning charges shall be binding on the government, and during which the maximum charge shall not be greater than a definite maximum rate, even though the increase by periods of five years should bring it to that maximum before the end of the entire agreement period.

By studying this arrangement of charges carefully, a business man can see that certainty as to maximum can be ascertained. He will always have the chance, by showing that the increase would undoubtedly be burdensome, to hold the payments below the possible maximum. The present Forester certainly will make no charge high enough to cause a prudent business man to hesitate about taking out a new permit or continuing to operate under an old one. The restrictions as to maximum will protect permittees to that extent against future administrative officers, and besides they can naturally have the reasonable expectation that such officers will exercise good sense and deal justly with the users of government resources.

I am sure that you, from your intimate acquaintance with Mr. Pinchot, will know that he is not doing anything that he does not consider just and fair. That the charges are not prohibitive is shown by the fact that new applicants do not hesitate to agree to accept them, provided that the same rates of charge are made to others who will be in the same business. Frankly speaking, the objection to the payment is merely the natural aversion which all people have, to giving up money so long as there is a chance of holding it.

Governor Rollins need have no fear whatever that the investments in which he is interested will be prejudiced by any action of the Forester. Mr. Pinchot has agreed to refer the conservation charge feature to the Attorney General for a further opinion before proceeding to fix and collect such charges. Very sincerely yours,

(Signed) G. W. WOODRUFF, Chief.

MEMORANDUM CONCERNING CONSERVATION CHARGE.

After careful consideration the Secretary of Agriculture has decided to place all permittees upon forest reserves, whose permits involve the generation of electricity by the use of water, in the same position as to a definite and reasonable annual charge to represent "conservation;" by which is meant anything furnished by the government to the permittee besides the area of ground actually occupied by reservoirs, power plants, etc., and the *length* of line actually occupied as a right of way. In the case of electrical plants the Secretary believes that the proper *measure* for a conservation charge is the amount of water used and the fall furnished. The Secretary does not charge for the water itself which, he recognizes, is granted directly by the State. He merely uses the water as a *measure* of the conserving effect of the maintenance of the Forest Reserve.

The water used and the fall result in horsepower. For this reason it was originally intended to make an annual charge of seventy-five (75) cents for each theoretical horsepower to be developed by any permitted electrical plant. The Secretary, however, upon representations by interested permittees, has decided to go one step further for the measure of conservation,

namely, to the meter which shows the amount of electricity actually developed. The proposition is to have a responsible Forester officer read this meter from time to time and report the electrical energy indicated upon it. This reading will be made in the presence of the company's foreman, and payment will be required at the rate of twenty cents per one thousand kilowatt hours. The Secretary plans to have this conservation charge take effect from the date upon which any plant is actually put into operation, but in no case to make it retroactive beyond July 1, 1906.

I recently informed one or two interested permittees of this plan for fixing the conservation charge, and have received many telegraphic requests to defer final action until a hearing upon the merits of the cases; but I realize that a general hearing would not be satisfactory from every standpoint, unless after the discussion of this question by individual permittees. For this reason I am sending to interested permittees an exact statement of the charge and the theory upon which it is based. I will be glad, if you desire, to have you write to me frankly and in detail on this matter, giving me information, if you are willing, on the following points:

1. What fall will you use in generating electrical energy under your permit?

2. What part of the conduit involved in this fall is actually situated within the Forest Reserve?

3. What number of cubic feet per second do you plan to run through your penstock when your electrical plant is running full capacity?

4. What class of water wheel do you intend to use?

5. Would you, as a practical matter, prefer paying a charge of seventy-five cents per theoretical horsepower as compared with a charge of twenty cents per one thousand kilowatt hours read from the above meter?

Note, that the charge per kilowatt hour would result in no charge whatever when you are unable to run for any reason, and would never involve a charge except for electrical energy which, for business reasons, you actually chose to develop.

6. Is it safe for the Forest Service to accept the reading of the meter at the transformer, as showing all the electrical energy developed at any particular plant? This question is asked because of the untechnical person's fear that in some way some of the electricity could be led by the meter and returned to the current beyond.

7. In detail, what loss of energy do you expect between the water wheel and the consumer, and what causes each item of loss?

8. What is the greatest distance to which you will transmit the electrical energy, and what is the average distance?

9. What kind of wire do you expect to use for transmission purpose?

10. What has been or will be the entire construction cost of your plant (or plants, if you have more than one) with details as to the different portions of the project? For example: (a) dam for storage purposes, (b) intake dam and headworks of canal, (c) ditch or other open water conduit, (d) pipe line used to carry water for definite power-producing purposes, (e) wheels and fittings, (f) power station, (g) pole line, (h) transmission circuit, (i) dynamos and equipment, (k) transformers, (l) distributing lines, (m) miscellaneous.

11. What do you estimate will be the actual operating expense of your business per year, with as much detail as you are willing to give?

12. What per cent. of the actual construction cost do you believe should be set aside each year, to represent deterioration of plant?

13. For what purposes are you selling or do you expect to sell the electrical energy, and what portion for each purpose?

14. How much do you get or expect to get per one thousand kilowatt hours for each purpose?

I recognize that for business reasons, the annual charge to any permittee should either be a fixed sum (like that of seventy-five cents (75) per theoretical horsepower), or a determinable sum, charged from time to time upon your actual production, and am convinced that the charge to be determined from your meter would make it possible for you to prove to any intelligent prospective investor the maximum cost to you per year as conservation charges, and that you should be able to convince him without difficulty that the heavier the payment to the Forest Service during any one year, the greater the profit to those interested in the project, because the charge would be paid only on electricity actually developed for sale and after the permittee has had opportunity to dispose of it for cash.

The Secretary is sure of his right to make this conservation charge, but will certainly make it a reasonable one. The questions in this memorandum are asked particularly to obtain data to ensure reasonableness of charge.

I would be glad to receive an early reply to this memorandum, because I want to hear from the Forest Reserve permittees of this class before sending to them the Secretary's final decision concerning conservation charges. Even if you want a personal hearing it would be to your advantage to answer this memorandum first to save time both for yourself and the Forest Service. Your reply to these questions will be treated confidentially and as for the use of the Forest Service only.

November 28, 1906.

BOOK REVIEWS.

United States Department of Agriculture, office of Experiment Stations, Irrigation and Drainage Investigations, Bulletin 177, Losses of Water by Evaporation—During the past few years experiments have been made by the office of Experiment Stations in co-operation with the State of California to measure the losses of water by evaporation from irrigated orchards in California, and to determine the effectiveness in checking these losses, of various methods of applying the water, and of cultivation after irrigation. The experiments included applying the water at different depths, varying from the surface to two feet, and of cultivation at varying depths, showing in every case a noticeable decrease in evaporation with increase in depth of applying the water and of cultivation.

Application for this bulletin should be made to the Director of the Office of Experiment Stations, Washington, D. C.

TRADE CATALOGUE.

General alternating current data are given in Bulletin 74, just published by the Crocker-Wheeler Company, Ampere, N. J., entitled "Engine Type A. C. Generators." This gives the bulletin value for all who have to do with alternating current. A number of views are shown of plants where Crocker-Wheeler alternators are installed, and the bulletin also goes into details describing the design of generators developed by the company. C-W engineers began designing A. C. machines about three years ago, when the company had had fifteen years of highly successful experience in D. C. design and manufacture. They based their work upon the designs of the celebrated Swiss electrical engineers, Brown, Boveri & Cie, acting under license from the Swiss firm. They therefore entered the field of A. C. manufacture unhampered by a costly stock of old designs, drawings and patterns, and were able to incorporate new and useful ideas in this class of machinery. The company met with instant recognition in this field and has accomplished remarkable results, especially in plants where the generators are driven by gas engines. One of the marked peculiarities of C-W alternators is their ability to operate in parallel; it was largely for this reason that the California Gas & Electric Corporation installed three 4000 K. V. A. Crocker-Wheeler alternators in its San Francisco plant. These are the largest generators ever built for gas engine drive.

The Association of American Portland Cement Manufacturers have sent out the first issue of a very attractive little folder to meet the growing demand for reliable information regarding the proper use of Portland cement. According to their announcement, it is the intention of the publishers to have original articles from the leading exponents of the various phases of the work.

INDUSTRIAL

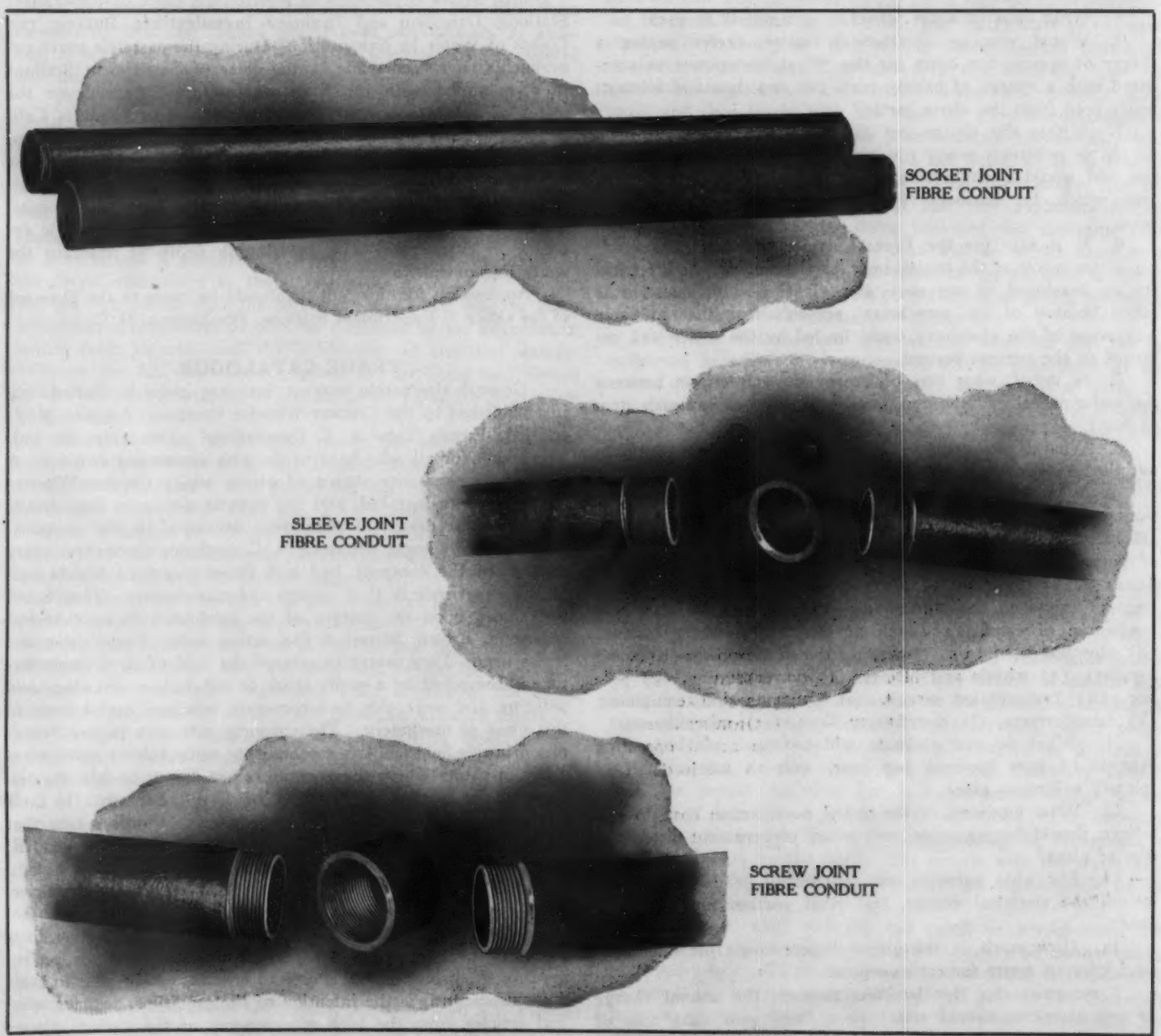
FIBRE CONDUIT: ITS MANUFACTURE AND USE.

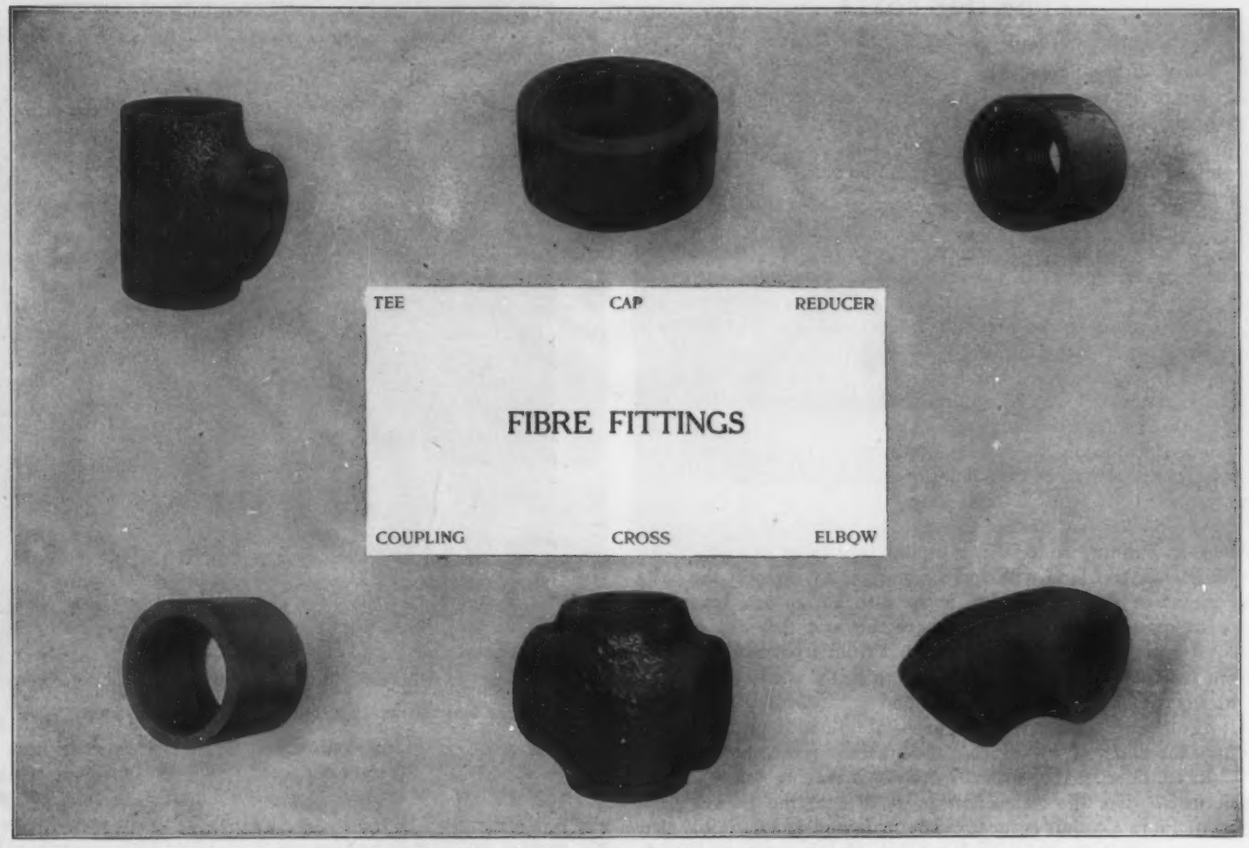
In designing an underground system for Telephone, Lighting or Street Railway Conductors the engineer is at the outset confronted by the problem of the character of material which shall surround the cables. His choice is limited under ordinary conditions to one of three possible materials. Depending upon the proximity of a tile manufacturing plant, earthenware, naturally would probably be first considered. Up to within the last five or six years earthenware was about the only material that could have been used.

Wooden ducts with grooves hollowed out to receive the cable are a possibility which, depending on the location, might be given some consideration.

Finally a body of concrete properly laid with the necessary ducts may be considered, provided the ducts can be lined with a softer material than concrete, which, at the same time will act as forms so that the concrete work may be easily and cheaply done. Such a material is offered under the name of Fibre Conduit, and this material has numerous advantages that may be studied with interest. Tile may or may not be laid in concrete, but if so laid, dependence is not placed entirely upon the concrete. A Fibre Duct must necessarily depend upon its concrete surrounding, and consequently in the examination of the Fibre Duct it must be considered in connection with concrete under ordinary circumstances.

A proper study of the particular conditions pre-supposes a knowledge of the character of the Duct product. In the process of manufacturing Fibre Conduit, wet wood pulp or fibre, is wrapped in a minutely thin film upon a forming mandrel, under pressure, until the desired thickness of wall is obtained, the individual fibres becoming inseparably united and forming a solid wall that s practically homogeneous. Taken off the mandrel, the wet pulp structure is subjected to an air drying process, after which it is placed in a vat of liquid compound. This compound is both preservative and insulating. It thoroughly permeates the entire structure so that after treatment the wall of the conduit, upon cutting, presents a strong resemblance to hard rubber. The ends are cut in a lathe to make a Socket Joint, Sleeve Joint or Screw Thread, as may be desired.





THE SOCKET JOINT TYPE.

The socket or slip connections that are cut on the ends of each length of Socket Joint Fibre Conduit are automatically turned, being ⅜ in. long, slightly tapering and uniform in size. As the joints are automatically formed, the connection secured in laying the conduit is perfect in fit and alignment. The inside of the joint is reamed during the process of cutting so that there can be no off-set at the joints when laid.

THE SLEEVE JOINT TYPE.

In this type of Fibre Conduit, the ends of each length are turned down to fit snugly in a sleeve by means of which a water-tight connection is made. The ends of the pipe are squared and faced, which assures a tight fit. This sleeve is about four inches long and has a wall, approximately, ⅜ inch in thickness.

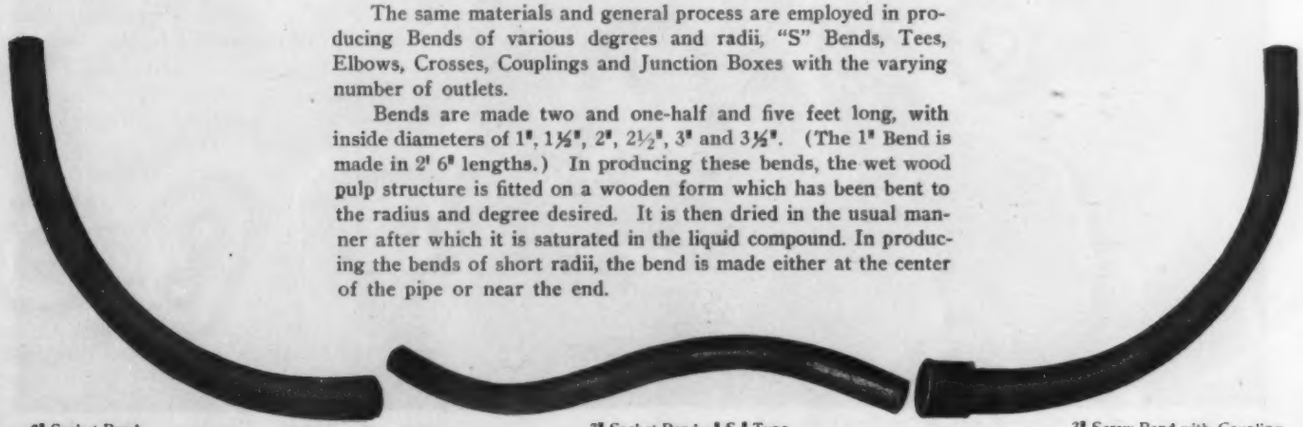
SCREW JOINT FIBRE CONDUIT.

This type of Fibre Conduit is manufactured with a slightly thicker wall than the Socket Joint type, owing to the necessity of securing a sufficiently heavy structure for carrying the thread that is cut on the ends of the pipe. The thread is "United States Standard"—four to the inch—and a coupling is provided for completing the joint. The ends of the pipe are squared and faced, thus assuring a perfect fit, one pipe against the other, when connected. The joints are screwed up by hand, no tongs being used. A liquid compound is furnished by the manufacturer to be wiped on the thread of the pipe when making the connection. This compound hardens and renders the joint absolutely water-tight.

BENDS.

The same materials and general process are employed in producing Bends of various degrees and radii, "S" Bends, Tees, Elbows, Crosses, Couplings and Junction Boxes with the varying number of outlets.

Bends are made two and one-half and five feet long, with inside diameters of 1", 1½", 2", 2½", 3" and 3½". (The 1" Bend is made in 2' 6" lengths.) In producing these bends, the wet wood pulp structure is fitted on a wooden form which has been bent to the radius and degree desired. It is then dried in the usual manner after which it is saturated in the liquid compound. In producing the bends of short radii, the bend is made either at the center of the pipe or near the end.



3" Socket Bend. 90°—36" Radius.

3" Socket Bend—"S" Type

3" Screw Bend with Coupling. 90°—36" Radius.

JUNCTION BOXES.

Fibre Junction Boxes are absolutely watertight and can be used with either Screw, Sleeve or Socket Joint Conduit. They are especially recommended for service connections and where it is necessary to light up private roads. These boxes are made two, three and four-way. The inside dimensions are, approximately, 8x8 inches and the weight is 16 pounds.

FIBRE FITTINGS.

In planning an underground conduit system, one of the most important points to be considered in selecting the material to be used is that which relates to the method of connecting one length of conduit to the next. The importance of this point lies in the fact that upon the method used depends the alignment of the completed system; the degree to which it may be made proof against water and gases; and also, the degree to which it will protect the cables from abrasions and cuts when drawn across the joints. In addition, the method of making the joint increases or decreases the cost of installing the conduit, depending of course on the type of conduit material used.

The method pursued in joining clay conduit, unit to unit, is either to butt the ends of the conduit together, wrap the joint with burlap, and bind with cement mortar; or, connect the units by means of dowel-pins, then wrap with burlap and bind with cement mortar. These methods are the best that can be employed where a clay conduit is used, but from a mechanical standpoint they do not lend sufficient strength to the conduit structure, and any settling of the ground around the system will throw it out of alignment, and will in all probability lock the cables firmly within the ducts, or will prevent the drawing-in of cables.

In considering the various methods of making joints in conduit installation, the connection as made with the Socket Joint type of Fibre Conduit is ideal. The male and female joints that are automatically turned on this type of conduit are so accurately cut that it is only necessary to push one within the other to secure absolute and permanent alignment, and without the use or a coupling compound, form a water-tight and gas-proof connection. Unlike the method pursued in laying clay conduit, it is not necessary to use a mandrel to secure alignment, neither is it necessary to wrap each joint with burlap to keep the concrete from seeping through the joints to the interior of the duct.

While laying a system of Fibre Conduit, employing the Socket Joint type, construction forces have found that the installation of the material proceeds usually at twice the speed required to lay other types of conduit and often times Fibre Conduit is laid even faster.

Besides the advantage in joining Fibre Conduit there are numerous other considerations that should influence the problem. Owing to the extreme lightness of Fibre Conduit, the expense of transportation and cartage is reduced to a small fraction of that of Clay Conduit.

Carrying 30 feet of 3" Socket Joint Fibre Conduit, weight 36 pounds

The following table shows the approximate weight of the various sizes and the average load for a one-team truck:

Inside Diameter	Approximate Weight per foot.	Average load One-team truck.
1 inch	0.50 pounds	8,000 Feet
1½ inches	0.70 pounds	5,700 Feet
2 inches	0.85 pounds	4,700 Feet
2½ inches	1.02 pounds	4,000 Feet
3 inches	1.20 pounds	3,300 Feet
3½ inches	1.40 pounds	2,850 Feet
4 inches	1.60 pounds	2,500 Feet

For handling about the trench, the lightness of this material is an added saving and convenience. On account of the easiness with which it is handled, great speed in laying is attained. A single layer, in installing one 5-foot length, handles six pounds as against forty-five pounds of the average clay. The bed of concrete having been prepared, the laying is very simple and the concrete may be tamped in place around and over it with practically no care and the cheapest labor.

The excavation required for this type of construction is anywhere from ten to twenty per cent less in cross section than that required for the heavier material. This item of the cost of labor should not be overlooked. That common labor can accomplish this is owing to the lightness and long length of Fibre Conduit, which eliminates a large number of joints; to not using a mandrel to secure alignment; to not having to wrap each joint with burlap; to not having to place cement mortar around each joint; and to the Socket Joint connection which insures perfect alignment and a perfectly fitting, waterproof connection.

In a recent installation of 30 ducts in parallel, one man in the trench and two helpers above, laid 6,500 duct feet of Fibre Conduit in four hours.

It is a common occurrence, during the installation of a Fibre Conduit system, for one gang of men, (two layers and three helpers), to average 12,000 duct feet laid every day during the entire construction period. In laying the Socket Joint type of Fibre Conduit, the follow-

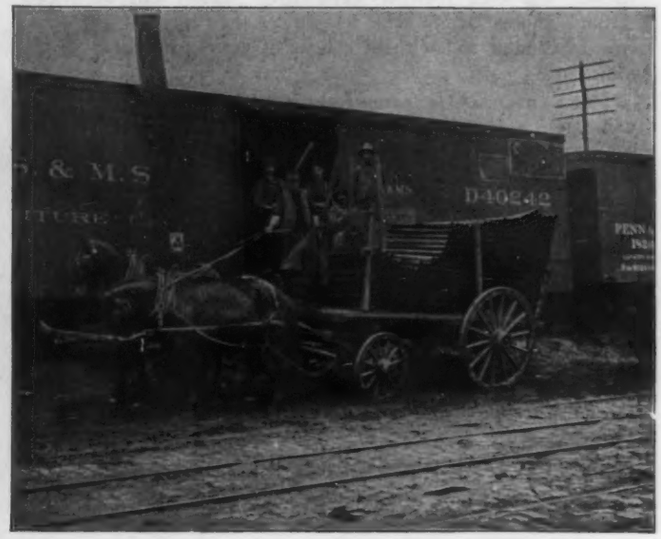
Cross Country Construction—Newark to Jersey City N. J.

Sioux City, Iowa

ing method is customarily pursued. After the trench has been excavated to the required depth, a base or bed of concrete, about 3 in. deep, is placed on the bottom and a line is drawn taut on one side, next to which is laid the first line of duct. The remaining lines of duct are laid parallel to the first line and are separated from each other ¼ in. to ½ in. by means of wooden or iron pegs. After the first layer is laid it is covered with concrete and to the depth of ¼ to ½ in. The succeeding layers are laid in exactly the same way. When the final layer of ducts has been installed, it is covered with concrete to depth of from 2 in. to 3 in., this final covering being sufficiently heavy to afford protection from possible disturbances caused by future excavations.

Where it becomes necessary to cut a length of the conduit, to break joints or enter a manhole, the remaining part of the length may be utilized by using a sleeve made of Fibre Conduit, having an inside diameter ½ in. greater than the pipe being used for the system. These Sleeves are about 4 in. long and fit over the ends of the abutting conduit, snugly, thus assuring perfect joints and alignment.

New Orleans, Louisiana



3" Socket Joint Type—25,000' Loaded in One Car

An important item to be considered in selecting the material for underground conduit system is the liability of the various conduits to injury from breakage. In a large number of underground conduit installations, the breakage "from factory to destination," "from car to ditch," and "on the street" has amounted to about 10 per cent of the entire shipment and the actual loss represented by such breakage has been close to 7 per cent.

The breakage of Fibre Conduit "from the factory to the bottom of the ditch" averages less than one per cent.

The customary process followed in rodding a conduit system is to push through each and every duct, a series of wooden or metal rods, composed of sections of such length as may be handled inside the manhole and arranged to be easily joined together. Then, successively, a rope, a mandrel, and a steel brush are attached to the rods and are drawn through each duct.. Owing to this method of procedure, a great deal of time is consumed in rodding.

Users of Fibre Conduit have found that satisfactory results are obtained by utilizing a No. 6, iron wire instead of the rods and the rope. The wire is pushed through each duct from one manhole to the next, then, the mandrels and brush are attached to the end and are drawn through, thus doing away with the rods and rope entirely.

Owing to the smoothness of the interior of Fibre Conduit and the perfect fit at the joints, the wire does not encounter any off-set at the joints nor any concrete that usually is found to have seeped through the joints, when other types of conduit have been used.

On account of the manner in which Fibre Conduit is manufactured, the interior of the duct is finished with a perfectly smooth wall, without burs or blisters of any description, thus giving an absolutely smooth surface for the drawing-in of cables. It is a recognized fact that about 90 per cent. of all underground cable trouble is directly traceable to some injury to the lead-casing of the cable which takes place when the cable is being drawn into the duct; or to lack of protection which should be afforded to the cable after being placed in the conduit. The injuries to the cable while being drawn in are usually caused by burs or blisters on the interior of the conduit, or to nipples of concrete that have seeped through the joints and formed and hardened on the bottom of the duct. In drawing the cable over these defects the sheath becomes seriously abraded or cut. The lack of protection to the cable in the duct is usually from loose and non-water proof joints, which allow stray currents access to the cable.

Injury of any description to the cable sheath is prevented by the use of Fibre Conduit, as the interior or bore is uniformly

smooth and each joint is water-tight. Cables can be drawn through Fibre Conduit with less power than through any other type of conduit and without danger of cutting or abrading the cable-sheath.

This material is extensively used in chemical works and will safely carry vinegar, diluted sulphuric acid and other corroding liquids at fairly high temperatures.

A test on Fibre Conduit at the School of Mines, Columbia College, New York City is reported as follows: "The conduit stood 10,000 volts alternating; when the static voltmeter in the secondary read 10,000 volts, the primary Cardew read 33. The static voltmeter was then disconnected, 10,000 volts being its limit and the voltage was further increased. When the primary read 71 volts, a discharge took place, through the air, around the edge of the pipe, but did not break it down. From these figures, the break-down voltage is higher than 25,000 volts, alternating."

Fibre Conduit has been in use at the power plant of the Telluride Power Company at Provo, Utah, since early in 1904, for carrying 40,000 volt transmission cables.

The St. Paul Gas Light Company, of St. Paul, Minnesota, is using Fibre Conduit for carrying 30,000 volt cables overhead in its power house.

It has been asked to what extent Fibre Conduit is waterproof and the opinion has been expressed that it might in time absorb sufficient moisture to destroy its insulating properties. To ascertain to what extent there is any risk of this occurring, two lengths of conduit were entirely immersed in water for two weeks. At the end of that time these lengths were taken out, one end was plugged up and the interior was filled with water. Some bare copper wire was then wrapped around the outside of the conduit several times, and this was connected to one terminal of a high tension alternating current supply, the other terminal of the supply being connected to the water. The pressure was gradually increased from 500 volts until the insulation broke down. One length of conduit sparked through at 11,000 volts and the other at 13,000 volts. The thickness of the wall of the conduit tested was ¼ inch only. It will be seen, therefore, that the specific insulation resistance of conduit that had been immersed in water for a fortnight was several times that of dry air, and the test appears to prove conclusively that Fibre Conduit is not liable to absorb sufficient moisture to destroy its insulating properties.

Opinions have been made, and at first sight they appear to be sound, that Fibre Conduit, being composed of woodpulp and a bituminous compound, would stand considerable risk of a fire spreading from one end of the duct to the other should an arc be started at any point. Possibly the best reply to this opinion is the result of an experience in a large installation in Brooklyn, N. Y. A heavy short circuit occurred in a 3-inch conduit. The cables were melted into a solid mass of copper and lead of nearly 1-in. cross section. In spite of the intense heat necessary to melt the conductor to this extent, the conduit was hardly damaged. The wall of the conduit directly below the destroyed cables was slightly charred and the arc formed appeared to have burnt away a portion of the top wall of the conduit, and the carbonized remains were clinging to the top surface. The important point is, however, that the fire did not spread. Similar burnouts in clay conduits have destroyed the conduits, as the intense heat has caused these to crack and shatter to pieces.

Fibre Conduit has been extensively used by many of the largest railway and lighting companies in the east. The installation across the Newark Meadows from Newark to Jersey City, is probably one of the best instances. The foundation for this particular distance is not of the best but this Conduit and its surrounding concrete have given perfect satisfaction since it was put in.

For Power House and sub-station wiring, where large cables are used, Fibre Conduit is particularly applicable.

The extent to which it is used may be judged from the fact that the Edison Company of Brooklyn have installed during the past four or five years not less than 800,000 feet per year. During their experience with this material a number of short circuits occurred within the Fibre Duct. In no case was this serious and the Fibre withstood burn-outs, which would have caused tile to go to pieces. A very heavy short circuit lasting as long as twenty to thirty minutes will burn out anything, and in the case of tile is apt to cause the flames to burn through the thin wall and communicate with the cables in the next duct. In the case of Fibre but one cable will be injured, as the Fibre has not only its own wall, but a protection of at least three-quarters of an inch of concrete. In addition to this fact, it has been found that a short circuit in tile duct will invariably cause the duct to fuse with copper and its lead sheathing, creating an obstruction that necessitates usually a street opening to clear and new sections of tile to repair the subway. With a short circuit in Fibre Duct, there is seldom any damage that cannot be remedied with rod and brush. If the short circuit is of sufficient duration to entirely consume the Fibre Duct, the cement casing around the Fibre is uninjured, as, of course, cement concrete is a better fire-resisting material than tile.

On the whole, the advantages in connection with the use of this material are of such importance that they cannot well be overlooked in selecting a material for subway construction. Where high labor costs are of great moment, as on the Pacific Coast, the difference not only in first cost but in cost of finished subway, is even more noticeable than under average Eastern conditions.

ALLIS-CHALMERS INDUCTION MOTORS IN A PAINT MILL.

The ordinary user of electrical power is familiar with the many advantages which are inherent in the induction motor when applied to practically any system of motor drive. But it is only when an application is made of this efficient machine to uses in which it alone is capable of adequately meeting requirements, that the full value of the induction motor is apparent.

Aside from the well known advantages of this type of motor from the point of view of mechanical efficiency, one very important feature is its absolute safety and freedom from fire hazard in places where any other type of power machinery would be more or less of a menace. This quality has recommended the adoption of induction motors for use in paint mills and powder mills where the consideration of safety is paramount.

Not long since the Wadsworth Howland Company of Chicago, paint manufacturers, burned out, and, instead of rebuilding, purchased the paint works of the Geo. W. Pitkin Company, which was being equipped with Allis-Chalmers induction motors of the latest type.

The entire induction motor equipment aggregating 300 horsepower was placed with the Allis-Chalmers Company. The power installation is entirely electrical, including electric lighting, the underwriters allowing no gas or burning of oil in the building.

Thirty horsepower motors will drive six lead mixers, 10 horsepower motors will drive the white lead and putty chasers, three motors being used on tandem mills, 5 horsepower motors will be used on No. 6-A sampling mills and others will be used for driving 20-inch water cooled mills.

The motors were built at the electrical works of the Allis-Chalmers Company in Cincinnati, Ohio.

AMERICAN CONDUIT.

The American Conduit Manufacturing Company, who recently completed their new factory of rigid iron conduit, have found it necessary to enlarge owing to the steadily growing demand for their product. Within the past year "American" conduit has become widely and favorably known on the coast, where it has been installed in some very large buildings. It has the distinction of having been used throughout the first class "A" building completed in San Francisco after the earthquake, namely, Flannery building.

NEWS NOTES

ELECTRIC RAILWAYS.

Boise, Ida.—J. E. Fourtellote & Co. have prepared plans for a one-story car barn for the Interurban Railway Co. It will be 75x150 feet concrete foundation, sand lime brick, sandstone trimming, tar and gravel roof, stone cornice, sheet glass, cement flooring, iron beams, skylights, electric light, etc.

Eugene, Ore.—A. Welch, general manager of the Willamette Valley Co., will make this city his headquarters for several months until the local street railway system and the Eugene-Springfield trolley line, the work on which is about to commence, is completed.

Hillsboro, Ore.—The Oregon Electric Railway Company of Portland has filed for record 35 right-of-way deeds, granting to the company right of way for its line through Garner Home, Tualatin and the eastern portion of Washington county. The deeds provide that the line must be in operation within two years.

North Yakima, Wash.—At a meeting of the stockholders of the Yakima Intervalley Traction Company the report of the engineer in the field was approved and it was decided to at once call for bids for the material to equip the road. The road will be built into the Moxee valley and thence to Zillah, a distance of 24 miles. Another line will be run to Wide Hollow, west of this city.

Olympia, Wash.—The right-of-way plat for a trolley line of the Mineral City Power & Transportation Company, has been filed. The right-of-way extends from Galena to Index along the line of the north fork of the Skykomish river. Rowland & McAllister secured a franchise.

Puyallup, Wash.—Actual construction work has been commenced on the new car line to connect Puyallup, Tacoma and Seattle.

Prosser, Wash.—The Prosser Traction Co., with a capital of $150,000, has been incorporated by Frederick Finn, J. W. Calicotte, G. A. Todd, George E. Boomer and F. A. Jenne.

Snohomish, Wash.—The Snohomish Valley Railway Co. has increased their capital stock to $2,500,000.

Seattle, Wash.—Black Diamond, Enumclaw and Auburn citizens are working to procure an extension of the interurban line of the Puget Sound Electric railway up the Green river to Enumclaw.

Seattle, Wash.—The Seattle, Renton & Southern railway is preparing to install an electric automatic switch at the intersection of Washington street and Fourth avenue south.

ILLUMINATION.

Lakeport, Cal.—At a special meeting the council granted a franchise to the Lake County Electric Power Co. to install an electric lighting and power system within the town limits. G. W. Scott and W. W. Van Arsdale, the millionaire lumber merchants, and Theodore A. Bell, are the principal stockholders of this corporation, which was organized for the purpose of distributing electricity throughout Lake county. The company will receive its electricity from the plant of the Snow Mountain Power and Water Co., which is in course of construction on Eel river. Scott and Van Arsdale, ex-Senator J. N. Felton and others are interested in the Snow mountain project. They will run a high potential line through Lake county. It is the intention of the Lake County Electric Power Co. to have its lighting system installed and electricity turned on by next October.

Fullerton, Cal.—Sealed bids will be received by the city treasurer up to 8 p. m. March 18th at his office in the city hall for the purchase of a gas franchise. Each bid must be accompanied by cash or a certified check for full amount of bid, payable to the city treasurer. The franchise is offered for sale upon the application of George M. Ross of Anaheim, who promises to supply the city with gas within 90 days, if he gets the franchise.

Los Angeles, Cal.—Sealed bids are being received by the board of public works for furnishing and installing ten ornamental cast iron posts on Carr street, between Main and Hill, and the wires, connections, globes and fixtures for said posts, in accordance with plans and specifications on file in the office of the board of public works.

Los Angeles, Cal.—Articles of incorporation will soon be filed for a new gas company with capital of $10,000,000. Following board of directors has been elected: W. E. McVay, W. S. Bartlett, O. T. Johnson, J. F. Sartori, M. S. Hellman, E. T. Stimson, H. W. Frank, W. M. Garland, Randolph Miner, H. Jevne, W. F. Bottsford, J. E. Fishbur, W. D. Woolwine. They will proceed with the construction of an up-to-date gas plant and the work will be rushed to early completion.

Lakeport, Cal.—At a special meeting of the town council the Lake County Electric Power Co. was granted a franchise to install an electric light and power system within the town limits. G. W. Scott and W. Van Arsdale, and Theodore A. Bell, are the principal stockholders in the project.

TRANSMISSION.

Stockton, Cal.—The American River Electric Co. is to erect a large steam electric generator plant in this city in the immediate future as an auxiliary to its water power electricity generating plant on the American river. The report that the Central California Traction Co. was going to erect such a plant in this city is a mistake. The plant will consist of a 3000-horsepower Curtis-Turbine steam engine direct connected to electric generators of the latest pattern. It will cost nearly a quarter of a million dollars and will be kept under steam all the time, but it will be operated only on the failure of the water power plant. It is to guard against lapses in the service that the auxiliary steam plant is to be erected in this city. Col. W. R. Johnson, of the American River Electric Co., says that his company had purchased the south half of block 23, bounded by Madison, Lindsay, Monroe and Fremont streets, and that the above described plant will be erected on that property. He says that the plant will probably be in operation all of the time, as the company had contracted to furnish about all of the electric power that both its water power and steam power plants will generate.

Lemoore, Cal.—At the meeting of the board of trustees recently H. C. Watson appeared before the board and presented a request for a franchise to lay pipes and string electric wires through the corporate limits of the city for the transmission power. Mr. Watson was requested to present his request in writing at the next meeting.

Manton, Cal.—The Northern California Power Co. and the Pacific Power Co., rival claimants to the waters of Battle creek, are each rushing sites five or six miles west of Manton. These two companies have filed upon the same water rights, and the company which succeeds first in appropriating the water will secure title. The Northern California Co. is preparing to put in a dam across Battle creek 150 feet in height, while the Pacific company will put in a dam also two or three miles further up the creek. A large number of men are engaged in preliminary work at both camps, and all available teams in the country are being pressed into service. All the standing lumber at the two Forward mills has been bought up, and lumber is now being cut and hauled green to the scene of operations as fast as possible. The storms and bad roads are greatly hindering the work. Developments are being watched for with a great deal of interest.

INCORPORATIONS.

Phoenix, Ariz.—The California Rapid Transit Railroad Co. has filed its incorporation papers at Phoenix. The capital stock is $10,000,000. The places to and from which the lines of railroads, including the branches, are to run, is described as follows: Commencing at and in the city and county of San Francisco, and running thence through said city and county along such route as may be selected through or near Burlingame, San Mateo, Redwood City, Palo Alto, San Jose, Monterey, and thence to the southerly shore of Monterey bay, thence to Carmel river, a distance, as near as may be, of 140 miles. At some point near San Jose a branch is to commence that will run through Alameda county, via Alameda, Oakland, and Berkeley, thence to Point Richmond, and terminating at Martinez, Contra Costa county, a distance of 75 miles. Commencing at a point near the lines of the main track at Redwood City through Palo Alto, to connect with the line at San Jose, a distance of 22 miles. It is contemplated to build a line from some point between Redwood City and Palo Alto, thence east to the bay of San Francisco, and cross at Dumbarton Point, thence to the city of Niles, the branch mentioned to be 13 miles in length. The total aggregate mileage of the railroad and its branches is 250 miles, as near as may be. The life of the corporation is to be 25 years, and may be prolonged in additional periods of the same length perpetually. The incorporating directors consist of three, appointed to hold until additional directors are elected, as provided for in the by-laws, and are as follows: William G. Alberger, L. E. Lee and William Minto, all of San Francisco. The temporary officers elected are William C. Alberger, president and chief engineer; L. E. Lee, secretary; William Minto, vice-president; W. H. Hart, treasurer. It is certified that $250,000 of the capital stock has been subscribed for by the following persons: W. J. Morgan, H. C. Curting, W. H. H. Hart, A. H. Butler, M. D. Eddy, H. P. Bowie and C. W. Clark, 200 each; L. E. Lee, Wm. C. Alberger and Wm. Minto, 50 each; California Tunnel Co., 950. Total, 2500.

Los Angeles, Cal.—Articles of incorporation of the Home Gas Co. have been filed, with a capital stock of $6,000,000. The object of the corporation is to establish an independent gas plant in Los Angeles. There is a possibility of a movement looking to a consolidation of interests between the above-named company, the People's Gas and Coke Co., and the company now in process of formation by Dr. John R. Haynes and associates. Dr. Haynes has already expressed himself as favoring such a plan. W. Arthur Phipps of Pittsburg heads the Home Company, and Edmund Mitchell is vice-president. Other members of the board of directors are William M. Hiatt, Edward M. Selby, William A. McDonald, John Teefer, E. B. Burton, R. H. Burton and B. O'Neal, all of Los Angeles. Thus far but $900 of the capital stock has been subscribed, but it has ample backing, according to Mr. Phipps' statement.

San Francisco, Cal.—The Mohawk Land and Water Co. has been incorporated with a capital stock of $25,000, by W. J. Woods, J. V. Chase, L. P., E. M. and P. C. Boardman.

Santa Barbara, Cal.—The Carneros Water Co. has been incorporated with a capital stock of $10,000, by J. H. Bishop, Robt. Main, Ida G. and S. P. Stow.

FINANCIAL.

Pomona, Cal.—The board of city trustees at its last meeting took up the matter of the proposed bond issue, the date of election being set for March 14th. G. A. Lathrop of the water company addressed the board advising that the $300,000 bond issue for the purchase of the plant and $25,000 for betterments of the system be submitted separately. He suggested that $10,000 of this be used for the construction of a pipe line from a point north of the Santa Fe railroad to Third street, from which laterals should be run.

San Diego, Cal.—March 12th is the date set for the election to vote on an issue of $885,000 bonds for sewer and water works extensions, grading, fire department and various other improvements to be made by the city.

Oakland, Cal.—With the final details of the transfer of the Contra Costa Water Co. to the People's Water Co. completed, the formal passing over of the old corporation's holding took place last week, and the People's Water Co. is in full control of the water supply of Oakland, Alameda, Berkeley and all the adjacent territory as far as Haywards and Alvarado to the east and south in Richmond in Contra Costa county. The Contra Costa supply developed for Point Richmond and undeveloped as yet for a big territory in Contra Costa county is in the watersheds of San Pablo and Wild Cat creeks. These sources of supply are controlled by the Syndicate Water Co., which passes out of existence and is merged with the new company. The closing of the water companies' deal consummates one of the heaviest financial transactions of the county for years. It involves a stock issue of $20,000,000 and a bond issue of not less than $10,000,000. The report filed by Manager McGary shows that the receipts of the company for the past year were $1,139,139, of which amount $772,746 came from the city of Oakland, or more than 60 per cent. of the company's revenue. During the year the new construction work of the company called for an outlay of $254,021. The operating expenses for the year were $308,279. The aggregate charges for operating expenses, new construction, taxes and interest amount to $947,714, leaving a net revenue of $191,425, if no allowance is made for the $250,000 which has gone into the new construction account and betterments of the plant.

TELEPHONE AND TELEGRAPH.

San Francisco, Cal.—W. R. Hewitt, chief of the department of electricity, filed with the board of supervisors Tuesday an estimate of the cost of construction and equipment of a building and repairs of works under the jurisdiction of the department named. The estimate calls for a total of $590,000. Hewitt asks that the school lot on the north side of Grove street, between Larkin and Polk, be assigned to his department. He figures that it will cost $200,000 for the building, which will include general offices, machine shop, necessary switchboard machinery, motor generators, battery room and underground testing plant. Ten police central stations will cost $25,000 additional. The rehabilitation of the underground system in the burned district, the fire and police boxes and other equipment will require $275,000 more, while the repair of the overhead system will cost $50,000. Hewitt also asks for $40,000 for a stable, including horses and wagons for use of the department. He was the first to respond to the provisions of the resolutions recently passed by the board of supervisors calling on city officials to file an estimate of the cost of rehabilitating their departments.

New York, N. Y.—It has been disclosed that the Mackays, who control the Commercial Cable and Postal Telegraph systems, have become the largest stockholders of the American Telegraph and Telephone Co., which controls almost all of the Bell telephone lines in the United States. This information came through the application made to the Stock Exchange to have listed there the common and preferred stock—about $100,000,000 in all—of the Mackay companies, the holding concern for all the Mackay telegraph and cable lines. The application for listing was granted, and the Mackay shares no longer will be dealt in on the curb. The Mackay holding concern has stock in 102 telegraph and telephone companies, including the Pacific States Co. It also owns Western Union stock, which fact affords a basis for the report that a merger of the two great telegraph companies is not improbable.

Anatone, Wash.—The Farmers Mutual Tel. Co. has been organized by G. E. Campbell, George Zimmerman, W. F. Hurst, Walter Sangster, Perry Barnes and W. C. Halsey.

Bellingham—The Larson Lbr. Co. will build a private telephone line ten miles in length.

Chemawa, Ore.—The farmers of Brooks, Lake Labish, Chemawa and surrounding settlements have decided to incorporate and erect a new telephone line in that section.

La Grande, Ore.—The Home Independent Tel. Co. has been incorporated with a capital of $75,000 by W. H. Behnenkamp, W. J. Church, S. D. Crowe, William Miller and J. L. Caviness.